attributed in England to Euclid's definitions, postulates, axioms, and propositions. Euclid's system was here regarded as the highest, and an infallible, type of logical accuracy. That it is still so regarded by some people is evident from the somewhat flippant and jesting comments made on the circular of the Board of Education in some of the daily papers. It may not be hopeless to point out to the writers of such comments that Euclid in at least one instance contradicts himself. His definition of a circle, for example, makes it to be, not a *curve*, but a *surface*: "a circle is a plane figure bounded by one line which is called the circumference." This clearly makes a circle to be a surface, and, moreover, it is lacking in definiteness, because it does not say whether the plane-bounded figure is that which is contained within the circumference, or that infinite external space which lies outside. Again, if a circle is a plane surface, what becomes of the proposition that two circles can intersect in only two points? Further, Euclid made the mistake of supposing that every geometrical concept can be *defined*, whereas there are some that can be only *described*: witness his attempted definition of a straight line, which merely encourages a pupil to deceive himself with a vague word.

The imperfections of Euclid are an old controversy which need not be enlarged upon. His merit as a logician is very great, and his logic is, on the whole, a type of accurate reasoning. Those who took part in reforming his system sought at once to preserve his logical excellence and to improve the subject-matter on which it was to be exercised. This they tried to do by familiarising the beginner with the main concepts of geometry in ways more natural and more easy than those adopted by Euclid—by an early use of rule and compass, for example, which dispensed with that somewhat complicated and ridiculous problem which forms the very second proposition of Book i., "through a given point to draw a right line equal to a given finite right line," a most gratuitous stumbling-block to the beginner. They assumed the potent Baconian principle that "examples give a quicker impression than arguments." There is no doubt that the new system has made geometry much more easy in its initial stages for the young pupil, but it contains one great element of danger—it may, to a great extent, replace strict logic by rule of thumb, and accurate expression by slipshod language. Those who have to examine papers on geometry sent by pupils from scores of different schools must admit that this danger has not been averted, and the reason is easily found. *We are at present teaching geometry on syllabuses.* So long as this plan is adhered to, there will be most perplexing diversities in the sequence of assumptions and propositions in school teaching, not unmixed with inaccuracy of expression. The present writer knows from experience that it is necessary for an examiner to keep before him several books on geometry when dealing with the work of various schools, owing to the fact that a proposition which one pupil thinks it necessary to prove another assumes as an axiom. Moreover, the whole of the pupils of a school are sometimes found to speak of a circle as *touching* a triangle at its three vertices. This is a matter dependent on the individual teacher, and it cannot be cured by any syllabus.

There are, of course, several excellent text-books on geometry, with little difference in the order of propositions, but no one of them is universally adopted. The successful reformation of the teaching of geometry seems to require an authoritative text-book which will serve as a definite guide to all teachers—such as that sanctioned by the Minister of Education in France. In the absence of such a definite guide, the present somewhat chaotic system will continue.

The writer of this article suggested, in the columns of NATURE, in the early days of the reformed system, that such an authoritative book should be issued conjointly by the universities, but the university authorities felt difficulties. Why should not the Board of Education issue such a work? Its recent circular is in itself an excellent syllabus, but the practical teacher will regard it simply as one more added to the bundle which he already possesses.

There is one recommendation in the circular with which it is impossible to agree:—"Axioms and postulates should not be learnt or even mentioned"—that is to say, they are to be treated as suppressed premises. Now every mathematical physicist encounters occasionally what seems to be a fundamental contradiction of some proved result with other known results, and it is only after it is pointed out to him that his reasoning contains a suppressed premise that the difficulty is removed. The neglect of the explicit recognition of an axiom is the same in kind as the suppressing of an important premise.

Two excellent sentences, containing a fundamental truth, must be quoted from the circular:—"It should be frankly recognised that unless the power of doing riders has been developed, the study of the subject is a failure. Although examining bodies may continue to pass candidates who merely reproduce proofs they have learnt, eked out by definitions or other matter, masters should not be satisfied with this; *the only proof of knowledge worth having is the power of applying it to new matter.*" (The italics are ours.) This is, indeed, a great truth, the importance of which in the teaching of applied mathematics is still greater than it is in the teaching of geometry, and one which every teacher should lay to heart.

GEORGE M. MINCHIN.

PHOTOMETRIC UNITS.

AN important announcement with regard to the photometric units maintained at the Bureau of Standards, America, the Laboratoire Central d'Électricité, Paris, and the National Physical Laboratory, Teddington, has been issued by the Bureau of Standards in its Circular, No. 15, dated April 1, 1909.

It was at first intended to make this announcement simultaneously in America, France, and Great Britain, but circumstances prevented this. It is desirable, however, to state authoritatively that the agreement described in the subjoined memorandum has been arrived at, and has the approval of the gas referees; and that the photometric standards of the National Physical Laboratory are being maintained in accordance with it.

R. T. GLAZEBROOK.

Memorandum as to Photometric Units.

In order to determine as accurately as possible the relations between the photometric units of America, France, Germany, and Great Britain, comparisons have been made at different times during the past few years between the unit of light maintained at the Bureau of Standards, Washington; at the Laboratoire Central d'Électricité, Paris; at the Physikalisch-Technische Reichsanstalt, Berlin; and at the National Physical Laboratory, London.

The unit of length at the Bureau of Standards has been maintained through the medium of a series of incandescent electric lamps, the values of which were originally intended to be in agreement with the British unit, being made 100/88 times the Hefner unit.

The unit of light at the Laboratoire Central is the bougie decimale, which is the twentieth part of the standard defined by the International Conference on Units of 1884,

and which is taken, in accordance with the experiments of Violle, as 0·104 of the Carcel lamp.

The unit of light at the Physikalisch-Technische Reichsanstalt is that given by the Hefner lamp burning at normal barometric pressure (76 cm.) in an atmosphere containing 8·8 litres of water vapour per cubic metre.

The unit of light at the National Physical Laboratory is that given by the 10-candle-power Harcourt pentane lamp, which has been prescribed for use by the Metropolitan Gas Referees, burning at normal barometric pressure (76 cm.) in an atmosphere containing 8 litres of water vapour per cubic metre.

In addition to the direct intercomparison of flame standards carried out recently by the national loboratories in Europe, one comparison was made in 1906 and two in 1908 between the American and European units by means of carefully seasoned carbon filament electric standards, and as a result of all the comparisons the following relationships are established between the above units :—

The pentane unit has the same value within the errors of experiment as the bougie decimale. It is 1·6 per cent. less than the standard candle of the United States of America, and 11 per cent. greater than the Hefner unit.

In order to come into agreement with Great Britain and France, the Bureau of Standards of America proposed to reduce its standard candle by 1·6 per cent., provided that France and Great Britain would unite with America in maintaining the common value constant, and with the approval of other countries would call it the international candle. The National Physical Laboratory, London, and the Laboratoire Central d'Électricité, Paris, have agreed to adopt this proposal in respect to the photometric standardisation which they undertake, and the date agreed upon for the adoption of the common unit and the change of unit in America is April 1, 1909.

The following simple relations will therefore hold after that date :—

Proposed new unit = 1 pentane candle.
= 1 bougie decimale.
= 1 American candle.
= 1·11 Hefner unit.
= 0·104 Carcel unit.

Therefore 1 Hefner unit = 0·90 of the proposed new unit.

The pentane and other photometric standards in use in America will hereafter be standardised by the Bureau of Standards in terms of the new unit. This, within the limits of experimental error, will bring the photometric units for both gas and electrical industries in America and Great Britain, and for the electrical industry in France, to a single value, and the Hefner unit will be in the simple ratio of 9/10 to this international unit.

The proposal to call the common unit of light to be maintained jointly by the national standardising laboratories of America, France, and Great Britain the "international candle" has been submitted to the International Electrotechnical Commission, and through it to all the countries of the world which are represented on that commission.

It is hoped that general approval will be secured, and that in the near future the term "international candle" for the new unit will have official international sanction.

NOTES.

AT the anniversary meeting of the Linnean Society on Monday, the gold medal of the society was presented to Dr. F. O. Bower, F.R.S., regius professor of botany in the University of Glasgow.

WE regret to announce that Dr. G. von Neumayer, Foreign Member of the Royal Society, and for many years director of the marine observatory at Hamburg, has died at Neustadt, at eighty-four years of age.

EDMOND HALLEY, the second Astronomer Royal, died on January 14, 1742, and was buried in the churchyard of St. Margaret's, Lee by Blackheath, in the same grave as his wife, who had died five years previously. In 1854 the memorial stone being much out of repair, the Commissioners of the Admiralty, who by that time had the Royal Observatory in their control, evidently considered the tomb as a national monument, and replaced the stone by a new one, the old stone being removed to Greenwich Observatory, where it is now to be seen attached to a wall. By lapse of time the second stone now requires renovation, and we are glad to know that the Commissioners of the Admiralty have under consideration the question of the repairs to be done.

AN International Congress of Applied Photography is to be held from July 8–10 next at Dresden, in connection with a photographic exhibition. Particulars may be obtained from the secretary, Dr. Veisz, Winchelmannstrass, 27, Dresden.

WE regret to see the announcement, from the Berlin correspondent of the *Times*, that Prof. Wilh. Engelmann, professor of physiology in the University of Berlin, died on May 20, at sixty-five years of age. Prof. Engelmann, who held a professorship at Utrecht for many years before his removal to Berlin in 1897, was an eminent authority upon muscular and nervous, especially cardiac, anatomy.

PROF. C. D. PERRINE, of the Lick Observatory, has been appointed director of the Argentine National Observatory, Cordoba. His work with the Crossley reflector is to be taken over by Dr. H. D. Curtis, now in charge of the D. O. Mills expedition at Santiago, and the latter will be succeeded by Mr. J. H. Moore, of the Lick Observatory. Prof. Perrine will arrive at Cordoba at the end of this month, and he asks that all correspondence shall be directed to him there.

PROF. DAVID TODD, of Amherst College, Massachusetts, is about to undertake an experiment for determining the composition of the air at high levels, and the cause of mountain sickness. He intends to make several balloon ascents in a closed car from Canton, Ohio, the interior of the country being considered preferable owing to freedom from seaward air currents. Rarefied air will be pumped into the car to keep the pressure at normal. The Aëro Club of New England has offered Prof. Todd the use of its new balloon, the *Massachusetts*, of 56,000 cubic feet capacity, for the purpose of his experiments.

THE Blue Hills Meteorological Observatory, near Boston, is about to lose, by his resignation, the services of Mr. Henry Helm Clayton, who has been in charge of it since 1894, and has made it one of the most important weather stations in America. He is to be succeeded by Mr. A. H. Palmer, now at Harvard. Mr. Clayton intends to attempt shortly a balloon trip from San Francisco to the Atlantic coast, as a preliminary test of the possibilities of an air voyage over the Atlantic. He believes that he can accomplish these feats by taking advantage of an upper air current which appears to flow constantly eastward at a height of about two miles above the earth's surface.

AN incident reported from Wisconsin suggests something of the possibilities latent in "Christian science" and allied notions as a menace to public health. In the Legislature of that State there was recently introduced a Bill providing that, in connection with lessons in elementary hygiene, the pupils in the "public schools" should be taught how to avoid contagion and the commoner ailments. There immediately poured in hundreds of letters and petitions protesting against such a policy, as it would give children the impression that disease was real. The opposition was so strong that the Assembly Committee on Public Health, in spite of the efforts of three physician members, was intimidated into killing the proposal at its first hearing.